Effect of the Alaska Earthquake on Functions of PHS Hospital

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AN EARTHQUAKE struck Alaska on Good Friday, March 27, 1964. It began at 5:36 p.m. and lasted for 5 minutes. Its epicenter was in the Prince William Sound near Montague Island. Its intensity measured 8.4 units on the Richter Scale; by contrast the San Francisco earthquake was 8.3 units. Only one stronger earthquake has been recorded in modern times—the 1960 Peruvian quake in which many lives were lost.

Had we planned this earthquake, we could not have chosen a better time. In the late afternoon of Good Friday many office buildings were closed and many persons were driving home in automobiles, a relatively safe place to be. Everyone was awake and most persons were clothed. Even more important they had their shoes on, usually an important point in Alaskan survival. Fortunately, on this day and during the following week, temperatures ranged from 20° F. to 30° F. During approximately 4 months of the year the weather is severe enough to cause fatalities in a disaster situation if suitable clothing or shelter is not immediately available. Building fires for warmth in this disaster would probably have been as hazardous as the freezing cold. When the quake started, the electricity went off immediately. Had it struck at the same time of day 3 weeks earlier it would have been dark, and no one without a flashlight would have been able to see to rescue children, avoid falling objects, escape from breaking and falling structures, or avoid the numerous crevasses which were opening and grinding closed in the earth.

The city of Anchorage is largely built on an ancient glacial moraine. The soil beneath the town is characterized as glacial silt, a very fine powdered rock that was deposited in a large plateau by the glacial streams of approximately 1,000 years ago. The water action of the Cook Inlet and Ship Creek has washed deeply into the plateau, leaving steep bluffs overlooking the water. These bluffs afford a spectacular view of the inlet with churning ice action in winter and busy shipping activities in the summer. The snow-clad mountain ranges of the Alaska Peninsula glow in unbelievably beautiful colors to form the background. This spectacular view has made this land highly desirable for building of homes. However, even before the quake the soil of the bluff areas was known to be unstable and it was not unusual to hear of homeowners losing 4 or 5 feet of front yard into the inlet during the spring thaw.

The Public Health Service Alaska Native Hospital is located on one of the bluffs that overlooks Ship Creek. The quake caused a large portion of the bluff to break away and slide down toward the railroad yard at the foot of the bluff. This breakoff included a large portion of the hospital parking area. No cars were there at the time.

During the quake the hospital rolled and shook violently, thousands of cracks appeared in the plaster, and the falling plaster created so much dust that many thought a fire had broken out. The hospital is constructed with "wrinkle" joints or "expansion" joints that divide the building into four separate units. The four units broke apart at these joints as they were

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designed to do, and the sprawling building rolled and shook as four separate units. Without these joints, it is almost certain that the building would have been torn apart and suffered much greater structural damage than was actually incurred. Looking at these joints from the inside, several patients on the fifth floor said that they opened and closed repeatedly. At the height of the quake it was reported that about 2 feet of daylight could be seen through the breaks in these joints.

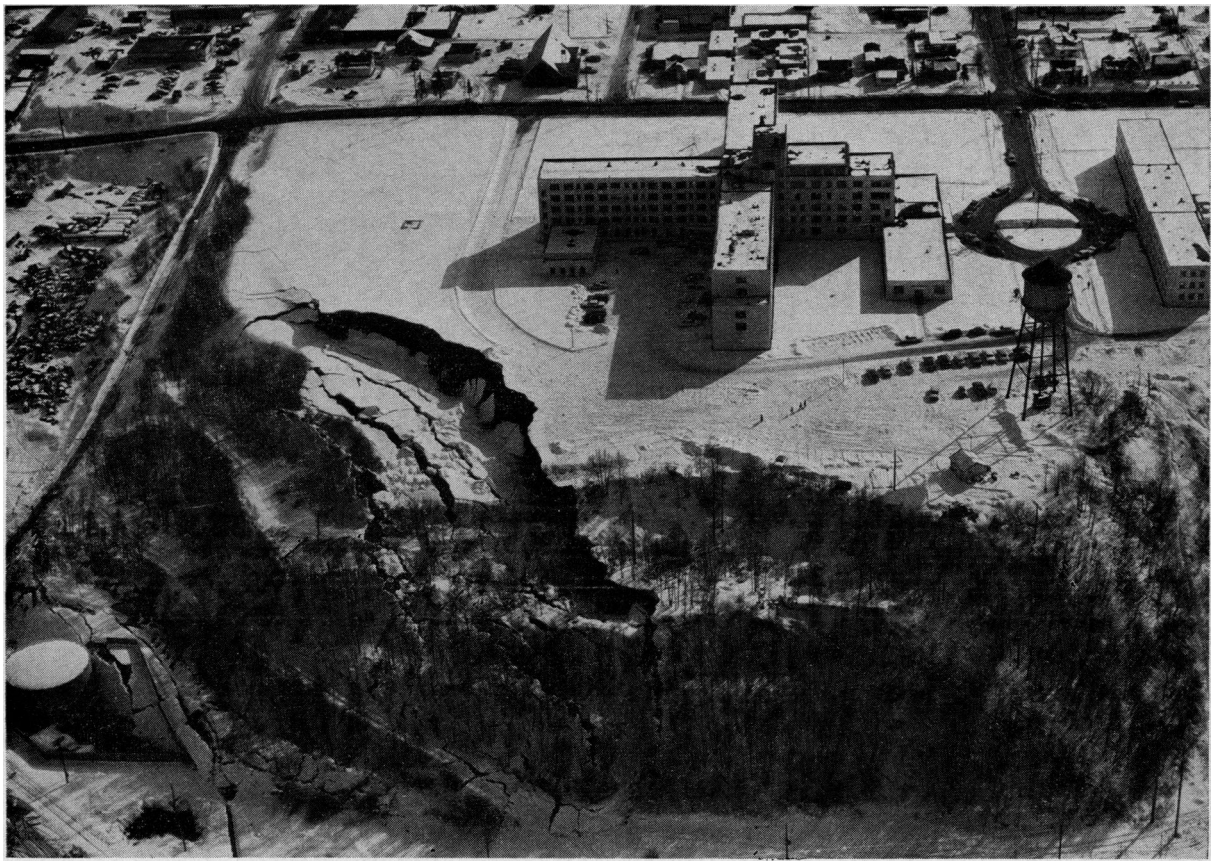
Each person in Anchorage, including our staff and patients, during the height of the quake was faced with the decision: "Should I get out of here or should I ride it out?" Some evacuated and some did not. In the circumstance of the hospital, it made no difference—all were safe. The officer of the day was in the emergency room at the beginning of the quake caring for a child with a broken leg. Several staff physicians were in the building and they, with the evening supervisor of nurses, immediately made rounds to assess the need for evacuation and to identify those patients or staff members who might be injured.

They found the hospital apparently structurally sound and noted no injuries among patients or staff. The officer of the day reassured the patients and asked those who had left the building and were standing out in the snow in their light robes and slippers to return to their wards. Members of the maintenance department arrived and started to restore utilities. The officer of the day then checked the oxygen tanks and anesthetic agents to determine if there was any leakage that would present a fire or explosion hazard. He opened the windows in the oxygen and gas storage areas and requested everyone to refrain from smoking. He then returned to the emergency room to see the child with the broken leg. This little boy had an agonizing night, and he would have certainly disagreed with our approval of the timing of the earthquake. He must have been frightened and in pain before the quake and he certainly was in much more pain after the violent shaking he received. Fortunately, the pain and fear subsided quickly after sedation and institution of traction.

Many of the staff were at home when the quake struck, and those whose homes were unsafe brought their families to the hospital. Two physicians, a husband and wife, riding home when the quake struck found their way blocked by great crevasses in the streets. They abandoned their car and ran the remaining eight blocks to their home, picked up their children and hitchhiked back to the hospital. The two main arteries leading from the town to the hospital were blocked by either debris or crevasses. It was possible to reach the hospital only by devious routes and small side streets. Radios and telephones were dead. Most of the off-duty staff returned to the hospital immediately because they thought they would be needed.

At the hospital at approximately 6:15 p.m., 38 minutes after the earthquake began, it was still daylight. Patients had recovered from their momentary fright and were helping the nurses clean up the debris. All electricity was off, and the maintenance department was working to restore the emergency generator. Steam was off, the hospital was cooling rapidly. Water was off and the water containers stored in the civil shelter in the basement were empty. Because there was no water and breaks were suspected in the sewerline, there were no sewerage facilities and toilets could not be flushed. The telephones, both within the hospital and those communicating with the city, were dead. Refugees in many categories were coming in.

The hospital, while structurally sound, suffered thousands of cracks in the plaster; dust, fragments of plaster, and ceramic tile were everywhere. All the chandeliers had been violently shaken and all were loosened to varying degrees and twisted out of their usual positions. About five fell to the floor during the quake. Fortunately, no one was injured. Fifteen were dangling, loosely supported only by their electrical wires. The shelves in medical records had danced around so violently that their bases were bent and they finally fell, depositing thousands of records in a jumble on the floor. Two huge circular files of X-rays danced around, fell, and dumped thousands of folders of X-rays onto the floor. The X-ray panels had been wrenched from the walls. Pharmacy, grocery, and warehouse storage were reduced to a rubble. Office cabinets and files were generally tossed about and papers dislodged and scattered.



U.S. Army photo

Aerial view of Public Health Service Alaska Native Hospital, with fissured area in foreground

All the shelves in the medical library were turned over. In short, the hospital was a shambles.

Despite the shambles, however, the hospital looked mighty good to staff members who had seen the downtown or Turnagain residential area where many buildings had collapsed or turned over or had fallen over bluffs. The entire staff helped to clear enough of the debris to prepare for the hundreds of injured persons anticipated from the downtown area, and they stayed on duty all night. Only eight persons were hospitalized for treatment of earthquake-related injuries. Several others were treated for moderate injuries and discharged. At all the hospitals throughout the city a total of only 17 persons were hospitalized for earthquake-incurred injuries.

Messengers provided the only communication with Civil Defense and with other hospitals and agencies, as the telephones remained out of service for several days. Messages were received in the central lobby, which was also our triage area. A transistor radio was brought in, and extra staff waiting for casualties congregated in this area to learn what was going on.

Fruit juice and sandwiches were placed on a rolling cart in the lobby and offered freely to all. Since many people had attended Good Friday church services in lieu of eating lunch, and only a few had had an opportunity to eat dinner before the quake struck, this simple food was most helpful to our staff, to refugees, and to many representatives of other agencies who stopped by the hospital on their official rounds of the city. The lobby was therefore quite crowded and appeared confused.

When it became apparent that no great volume of casualties would arrive, the Alaska Native Health Area director, the executive officer,

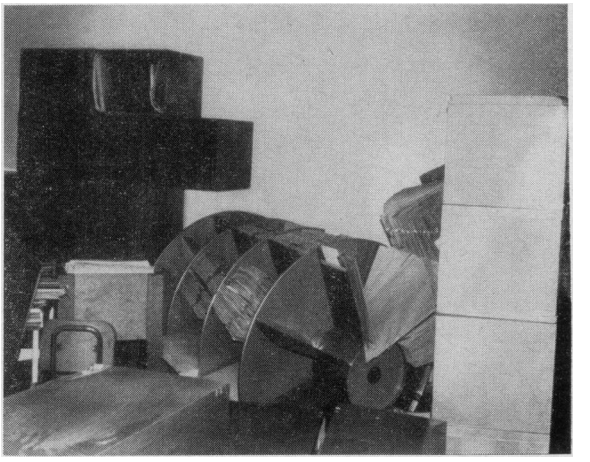
and the chairman of the disaster committee made rounds of other hospitals and agencies of Anchorage to inquire how we might be of service. The hospital at Elmendorf Air Force Base had suffered severe structural damage, but the patients had been evacuated to a nearby barracks. This makeshift hospital was functioning and had no need of our help. Later, we admitted two children with severe burns who were military dependents. The Presbyterian Hospital had also been evacuated because of breaks in the anesthetic and oxygen lines, and its patients had been transferred to Providence Hospital, which had adequate emergency water, steam, and electricity, and had quickly made provisions to accommodate both the Presbyterian Hospital patients and the earthquake casualties. Our messengers reported that Providence was functioning well and had no need of help from us. They also reported that Civil Defense had adequate volunteers for digging out and rescue operations and requested that our staff stand by to receive casualties.

Refugee families were housed in staff quarters and office buildings, mattresses were put down in offices and conference rooms, and the staff kitchen was used to supply meals to these families through Civil Defense arrangements. The night was a long and anxious one. Frequent, mild after-quakes gently shook the buildings and rather more severely shook the nerves of tired, apprehensive patients and staff who, however, responded calmly and with humor.

The following morning, Saturday, the general situation was reviewed at a staff meeting. The most pressing question was what had happened to the large volume of expected casualties. As far as we could determine all casualties that had been identified had received prompt and adequate treatment. The major concern was for the large number of injured we thought must be pinned in the collapsed buildings. We did not believe that many of these could survive the combined effect of their injuries and the cold. The reports of the extensive earthquake and tidal wave damage to the outlying areas were beginning to filter in, and Civil Defense requested us to brace for the reception of an unknown number of casualties from outlying villages. At this time, the medical staff was divided into two teams and was placed on an 8-hour-on, 8-hour-off basis. This enabled all to rest in preparation for the continually expected influx. Because it was not possible to restore the heat right away and the building was cooling, the patients' clothing was issued to them. Fur parkas, wool slacks, and mukluks became the uniform of the day for patients, nurses, and doctors. Space heaters, obtained through Civil Defense, were put on pediatrics wards.

The lack of water, steam, and electricity prevented any function of the laundry, and the director of nursing and the chief of housekeeping were requested to be extremely saving of fresh linen. By Monday morning, low-pressure steam was available for a limited laundry operation. A large flatwork ironer had been moved several inches by the quake and its steam pipes were broken. It was repaired and back in full operation by Wednesday morning.

The interruption of sewerage facilities presented the most disagreeable and potentially the most dangerous condition we had to contend with. Friday night after the quake all of the toilets were sealed and a "honey-bucket" system set up. The honey buckets were improvised from trash cans lined with plastic bags. We learned to our sorrow that one plastic bag was not strong enough—two are required to prevent breakage during emptying processes. Breaking of a well-filled plastic liner by definition converts a disaster into a catastrophe. By this



Tumbled X-ray files at Public Health Service Alaska Native Hospital after earthquake struck

Fissured and tumbled area, Anchorage. Public Health Service Hospital in background

definition, we suffered one disaster and two catastrophes. Water was restored on Sunday afternoon and the restoration of adequate sewerage was accompanied by general rejoicing.

Emergency Staff Committee

The difficulties caused by the earthquake naturally made operating circumstances different from their usual status. Differences that were critical, unless carefully managed, would be reflected in really serious problems for the future. The decision was made to appoint one strong and effective officer for each critical area. It was not so essential for this person to have direct experience in his assignment as that he be able to quickly grasp the significance of problems, use foresight and judgment in developing solutions, and act forcefully when necessary. A sanitation officer, an information officer, a quarters and subsistence officer, and a morgue officer were selected. These men all functioned effectively, both in this special assignment and in their everyday duties which were, of course, greatly magnified and complicated by the conditions following the quake.

While the staff remained braced for the influx of injured, it gradually became clear that the major contribution to be made was in the prevention of disaster-related epidemics rather than the treatment of earthquake-incurred injuries.

To this end, the staff joined in planning with the community's emergency health service, and we made all our facilities and staff available to them. The original disaster plan for the city called for the location of the emergency health service in either of two buildings, but both these buildings had been extensively damaged. Therefore, an office wing of one of our staff quarters was turned over to the committee. Physicians, nurses, sanitarians, nutritionists, and secretaries were detailed to the committee, and they participated in a communitywide typhoid immunization program. Several private physicians who had flown in from Fairbanks to offer their services helped us to man the clinics. One of the clinics was set up in the

lobby of another staff quarters building. The large number of persons coming to it created a traffic hazard both inside the building and along the drives; but there was no other reasonable alternative.

Village Evacuees

By Sunday afternoon it was clear that because of the time at which the earthquake struck there would not be great numbers of injured persons, and it seemed that the big strain on the staff would shortly be eased. That afternoon, however, all residents of the Kodiak Island villages of Old Harbor and Kaguyak were readied for evacuation to Anchorage. These villages had been totally destroyed by the tidal waves, and the people had saved their lives by climbing the mountains behind the villages. The villagers were airlifted to Anchorage on Sunday and Monday, and they were housed in a grade school building that had been converted into a temporary shelter. As they arrived, the refugees were screened by physicians for evidence of injury or need for medical attention.

All the villagers were Alaska Natives and therefore beneficiaries of our program. A Public Health Service physician who had made clinic trips to their villages and knew the medical background of each of these families met them at the school. Those in need of treatment were taken to the hospital.

The health program for Alaska Natives living in remote villages is carried on by public health nurses under the Alaska Department of Health and Welfare and by field physicians from the Public Health Service. These nurses and physicians travel to the villages by chartered bush planes, but because of limitations in staff and funds, these visits are less frequent and of shorter duration than would be ideal. To have the entire population of two of our remote villages within a few minutes' driving time from our hospital was an opportunity too good to miss.

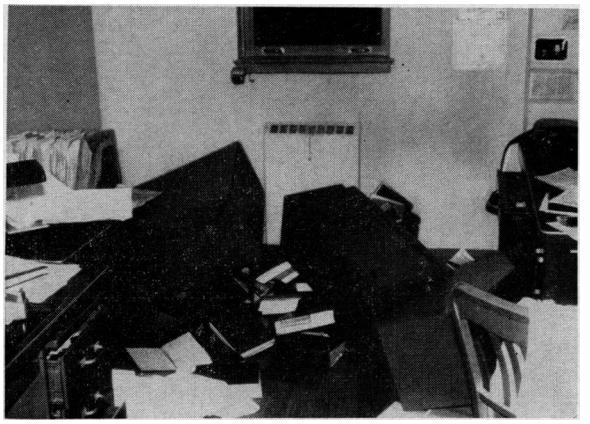
Chronic health problems were reviewed in consultation with specialists in pediatrics, ear, nose and throat, eye, internal medicine, surgery, and orthopedics. A portable dental unit was used at the school and much preventive dental service was given. The chief of medicine was detailed to the emergency health service for the general purpose of strengthening the tuberculosis casefinding and case followup program during the disaster and for the specific purpose of surveying the refugee population for tuberculosis. A portable X-ray unit was installed in the auditorium and all tuberculin-positive reactors were given chest X-rays. Several cases of active tuberculosis were identified among the children and these children were hospitalized. Several adults had suspicious films, and they were recommended for admission to the hospital for further study and for observation under chemotherapy. Because each of these adults felt a strong need to be with his family during the rebuilding of the villages, they requested the opportunity to initiate their treatment on an ambulatory "at home" basis. Inasmuch as these lesions were equivocal and their need to be with their families was so acute, a plan was worked out to give them supervised chemotherapy in their villages.

Practicing preventive medicine in anticipation of dental caries, tuberculosis, otitis media, and diseases of infancy is not usually considered a part of a disaster plan. However, morbidity problems in these fields are a constant threat and burden to the Alaska Native. We are unabashed in our opportunism in pushing the programs designed to confront these diseases.

Review of Disaster Plan

How closely did the management of the disaster follow the disaster plan that had been designed primarily to meet a nuclear attack? The circumstances of the earthquake differed widely from those described in the plan. The major value in our plan probably was the mental discipline that was required to develop it. The process of planning made each of us develop some knowledge of the resources and organization of other agencies and our proper relationship to them.

Disaster committees naturally work under many handicaps. Our committee had functioned extremely well despite many difficulties. Everyone on the committee had a heavy load of day-to-day responsibilities, and personnel turnover had been large before the earthquake



Surgeon's office at Public Health Service Alaska Native Hospital after earthquake struck

struck. All, except the chairman, had transferred, and some replacements were badly delayed. As an example, the hospital administrator should play an active role on any hospital disaster committee. Our hospital administrator had transferred to the States in August and when the earthquake struck at the end of March, his replacement still had not arrived. Nevertheless, the committee did a good job and the planning they had accomplished despite their problems was quite commendable.

Probably the best disaster planning always occurs just after a disaster. Experience is a stern teacher and motivation for adequate planning is at a high pitch. We have already modified our plan and have published a new one, attempting to incorporate all the valuable suggestions made by the staff. The format of the plan has been changed so that members of each department can see at a glance what his individual responsibility will be. We copied this format from the Hospital Disaster Plan of the Public Health Service Indian Hospital in Tuba City, Ariz. It includes two kinds of disasters, distinguished from each other by the use of different colored paper. The folder of the plan is bright and distinctive so it can be quickly identified in a file, on a shelf, in a strange department, or in a jumble on the floor. We suggest that the cover design of the hospital disaster plan be standardized for all hospitals so that even new employees would recognize it at a glance.

The revised plan designates to the service unit director the responsibility of deciding if patients' clothing is to be issued from the clothing room and when it is to be returned. Hospital policy has been revised so that patients retain their shoes at the time of admission instead of checking them in with their other clothing. Space available on the wards is inadequate to allow patients to keep all of their clothes with them.

The plan was also revised to allow use of patients as volunteers under the direction of occupational therapy and physical therapy departments to assist in various duties related to the disaster. An active and effective work tolerance program had recently been instituted at the hospital, and patients participating in this program played an invaluable role in the disaster. They performed as messengers, stretcher bearers, janitors, elevator operators, dietary helpers, and general straightener-uppers.

Since the Cuban crisis we have maintained a policy of color coding all patients on admission with regard to the severity of their illness, their ability to walk, and their need for absolutely continuous medical supervision. The color code is changed as the patient's condition changes. For ease of memory, we used traffic light colors with the same connotations carried by the different lights. Because we have a large number of tuberculosis patients we had the color coding conform generally to the activity classification recommended by the National Tuberculosis Association. The numerals shown in parentheses below are NTA activity classifications.

Color code	*Traffic connotation*	*Patient evacuation connotation*
Red	Stop	Stretcher case, acutely ill, continuous medical supervision imperative. (I)
Yellow	Caution	May walk but not strong. May need help. Continuous medical supervision desirable. (II)
Green	Go	May walk, is strong. Can help the patients with yellow code. Medical supervision can be intermittent. (III)

The patient's color code appears as a colored label on the front of his chart and as a strip of colored plastic around his plastic identification

bracelet. The color coding allows immediate classification of patients by nonmedical personnel even in the confusion of a disaster. It prevents the possibility of litter bearers carrying out a perfectly able-bodied patient and passing up one with a recent heart attack, the newly postoperative patient, or one with a fractured hip. As it happened we did not need this color coding in this particular disaster, but our experience with the policy has shown it to have value in daily routines, it is easy to keep up, and we recommend it for general adoption.

The hospital purchases its steam from a nearby private company. This company was temporarily put out of commission by the earthquake but recovered quickly. The steampipe system in the hospital had many breaks that required several days to fix. The most serious problem occurred where one of the steampipes crossed a wrinkle-joint and penetrated one of the main supporting beams. Repairing this particular break presented major problems, and the lesson we learned was that steampipes should not be designed to penetrate main supporting beams. Water valves, steam valves, and electrical switches should also be in accessible places. Some of these key valves in our hospital are located in a sixth floor room where the only means of entrance and exit is through the back door of the elevator. But the elevator shaft was damaged and there was no electricity for the elevator. In order to get into the room behind the elevator, a bridge had to be improvised across the elevator shaft. This inconvenient room was also the place where some of the disaster supplies were stored. This was known to be a poor place for such supplies but a severe shortage of storage space plagues us. The disaster committee is trying to find a better place for disaster storage.

Use of the outpatient department and emergency room for treatment of large numbers of casualties would have been difficult. The outpatient department had outgrown its original space and was recently moved into the administrative wing of the hospital. (The administrative offices, in turn, were moved to a ward which was originally planned as an isolation ward.) It was therefore poorly planned for management of large numbers of patients and this experience threw many difficulties into sharp relief. After the emergency was over, a committee was appointed to review the plan and to make recommendations for changes in it and in the arrangement of equipment and supplies for the meeting of "routine" emergencies and the needs of a disaster situation. The committee consisted of a general surgeon, an anesthesiologist, an internist, a pediatrician, a nurse, and a clinic physician. Their recommendations have been translated into architectural drawings, and construction will begin shortly. Supplies and equipment recommended by this committee are being purchased.

Since our emergency generator had only a 10-kv. capacity, the circuits wired into the emergency lighting system were limited to those in surgery and the emergency room. (Two babies who were born about 11 p.m. on Friday were welcomed in the delivery room by flashlight and emergency battery lamps.) However, the electrical circuits had not been changed since the outpatient department was moved into its present location. If we had had a disaster drill at night using the emergency lighting system, those defects would probably have been demonstrated and hopefully corrected. An extra generator was hastily borrowed and cut into the present emergency room circuit.

Our water supply was shut off for 48 hours. During this time, water was delivered to the hospital by fire trucks, was chlorinated, and placed in large drums for general use. On the advice of our sanitary engineering staff, water from the taps was not considered safe for drinking until an adequate series of negative bacteriological cultures were obtained. The containers of chlorinated water were used for drinking purposes for 1 week.

Discussion

What problems did we have that could have been prevented? What lessons did we learn? We gained several convictions from this experience that we hope will be of general value.

We believe that every hospital in a fairly remote area should be completely self-sufficient, and the first requirement for this is adequate emergency equipment to support basic utilities for a prolonged time. This would include an adequate electric generator. Although our emergency generator had been regularly in-

spected, at the time of the quake it failed. We were reduced to flashlights and emergency lanterns until two emergency generators could be borrowed from Civil Defense. Lighting was really inadequate during the first few hours, and it was fortunate that major emergency surgery was not required at that time. We are told that a 100-kv. generator would adequately support our operation, and we hope that this experience will lend justification to its purchase.

We were able to borrow an emergency steam generator also. This allowed a partial laundry operation, some heat, and it supported the autoclaves. Surgical packs were autoclaved for us by Providence Hospital. We were unable to sterilize baby formula, but we borrowed prepackaged, sterilized formula in sufficient quantities from Presbyterian Hospital until our formula room was restored. The lack of steam would have presented a formidable problem if the temperature had been −30° F. degrees and the wind high. Therefore, we are recommending the purchase of an adequate emergency steam generator.

Water is a continuous problem in a disaster. If we had a functional well and pump, we would always have water with which to meet both disasters and catastrophes.

How well were we able to communicate within and without the hospital and with communities outside of Alaska? How well did we coordinate with other agencies?

All telephone communications within and without the hospital ceased with the earthquake. We therefore set up a system of messengers or runners who were ambulatory patients within the hospital. Civil Defense provided a runner between the hospital and their headquarters. By Monday, 3 days after the quake, we obtained through Civil Defense, a two-way radio manned by an Air Force sergeant. We had no way to communicate with other agencies within the city except by automobile and no way to communicate outside of Anchorage until Sunday when Civil Defense made it possible for us to send a message through their ham operators. Shortly before sending our first message, we had received a garbled call from the Alaska Native Hospital at Mount Edgecumbe by ham radio. Dr. George Wagnon, medical officer in charge at Mount Edgecumbe, was then able to get word to other hospitals and to Washington.

On Saturday night Edward A. McDermott, director of the President's Office of Emergency Planning, U.S. Senators Ernest Gruening and E. L. Bartlett, and Governor William A. Egan met to discuss the impact of the earthquake and how the State might approach solutions in an orderly manner. An office of emergency health planning under the Alaska Department of Health Regional Health Officer had been established the day after the earthquake to coordinate health activities. Our hospital coordinated well with this group, with the other hospitals in Anchorage, with the President's Office of Emergency Planning, Civil Defense, Red Cross, and other organizations concerned with health mobilization. A message was conveyed by the Alaska Health Department in Juneau to the Public Health Service's Regional Office in San Francisco and its Office of Health Mobilization in Washington, and personnel and supply help was received in Anchorage within 48 to 72 hours.

Besides communications, one of the greatest problems during a disaster and especially during the rehabilitative restorative phase is proper coordination of all the agencies involved.

In summary, I believe the following considerations will aid greatly in maintaining order and preventing fear, anxiety, shock, and confusion on the part of all when disaster strikes:

1. A well-written, concise disaster document prepared for a within-and-without hospital disaster and easily identified and easily referred to.
2. Drills during the night at least twice a year as well as frequent daytime drills.
3. An active disaster committee which constantly reviews and updates the plan.
4. Assignment of specific areas of activity to specific officers who meet daily for report and instructions.
5. Auxiliary utility units that are functional at all times.
6. Proper labeling of patients in terms of emergency.
7. An integration of the hospital plan with those of the community and State.

Protection Against Measles in West Africa

A dramatic reduction in the incidence of measles occurred in the spring of 1964 in the new African Republic of Upper Volta as a result of a mass vaccination campaign conducted in 1963. Scientists of the Public Health Service's Division of Biologics Standards, National Institutes of Health, supervised research studies and the mass campaign against measles, which frequently killed 50 percent of the Volta children in villages struck by measles epidemics.

Since March 1963, when jet inoculation of 731,000 measles-susceptible children between the ages of 6 months and 5 years was completed, only 133 cases and no deaths were reported among vaccinated children, compared with 5,370 cases and 166 deaths among those missed in the campaign or born too late to participate.

Eight teams of trained Volta nurses, supported by the NIH team—Dr. Harry M. Meyer, Jr., Mrs. Barbara C. Bernheim, and Dr. Daniel D. Hostetler, Jr., Division of Biologics Standards—traveled by jeep throughout the African nation to administer the vaccine. This campaign was the first national attempt to control measles with the new live vaccine developed by Dr. John Enders and his colleagues at Harvard University.

Although it usually caused a mild febrile reaction in recipients, the vaccine was accepted by Volta parents who fear natural measles as the single biggest killer of their children. Frequently, mothers carrying babies walked 10 miles or waited by the roadside until long after dark to be certain they would not miss the mobile teams.

After an urgent request in November 1961 from the Minister of Health of Upper Volta, the National Institutes of Health initiated a field study which established that the vaccine, being used experimentally in the United States at that time, was equally safe and efficacious for African children despite the infectious and parasitic diseases and nutritional deficiencies which commonly afflict them.

In a second study, 550 children were inoculated with live measles, smallpox, and yellow fever vaccines, using an automatic jet injection apparatus.

Children line up for measles vaccination

The results indicated that jet inoculation of the vaccines, alone or in combination, was safe, effective, and a cheaper and faster way to immunize a population than the usual methods. During this project the NIH team taught the new techniques to Volta nurses. Both this study and the mass campaign which followed were sponsored by the National Institutes of Health and the U.S. Agency for International Development.

The success of the mass campaign was reported by the Health Ministry of Upper Volta at a Paris meeting of the Organization de Coordination et de Cooperation pour la Lutte contre les Grandes Endemies, a regional West African organization, in May 1963. The other member nations—Ivory Coast, Dahomey, Niger, Mali, Guinea, Senegal, and Mauritania—proposed a measles vaccination training and demonstration project for the fall of 1963.

To prepare for this multinational project, nurses from each of the seven nations were trained in Bobo-Dioulasso, Upper Volta. Dr. Meyer and Mrs. Bernheim were technical directors of the AID-financed project. The NIH team and its Volta colleagues then traveled by jeep to conduct a demonstration vaccination campaign in an area designated by the ministry of health of each country. By January 1964, when the project was completed, the U.S. and Volta teams had traveled approximately 20,000 miles and vaccinated 100,000 children, or about 15,000 in each country.